Safety Science 76 (2015) 145–150

Contents lists available at ScienceDirect

Safety Science

journal homepage: www.elsevier.com/locate/ssci

# Preserving and improving the safety and health at work: Case of Hamma Bouziane cement plant (Algeria)

Chaib Rachid [a,*], Verzea Ion [b], Cozminca Irina [b], Benidir Mohamed [a]

[a] Laboratory of Transport Engineering and Environment, Department of Transport Engineering, University Constantine 1, Algeria
[b] Technical University, Iasi, Romania

ARTICLE INFO

*Article history:*
Received 2 August 2014
Received in revised form 1 November 2014
Accepted 27 January 2015
Available online 20 March 2015

*Keywords:*
Safety and health at work (SHW)
Safety culture (SC)
Pareto diagram
Ishikawa diagram
Deming wheel

ABSTRACT

Safety and health at work (SHW) has become a public health priority in industrialized countries and a primary concern in the context of human resource management and in particular high risk-industries. Thus, developing a strong safety culture (SC) would be a mean to reduce the number of adverse events related to various activities in the company. Now, the laws and customs interact: when a people have good manners, laws become simple. Unfortunately, habits cannot be modified by setting example. Therefore, regardless of the size and activity of the entity, health and safety at work must be at the heart of its daily management. In the absence of effective management of health and safety at work, it is the entire company that is mismanaged. On the whole, risk management can be defined as a process of prevention and protection allowing a company or an entity, placed in a competitive context, to take all necessary decisions in order to optimize its activity, without affecting its customers as well as the environment. This work is an opportunity to initiate a global approach to prevention in cement plants whose purpose is to improve working conditions by technical, organizational and human solutions to improve the health and safety of employees while engaging in a process of continuous improvement.


## 1. Introduction

During work, any employee may be the victim of industrial accident or contract an occupational disease resulting:

- Temporary incapacity for work (TIW).
- Permanent partial disability (PPD).
- Death putting an end to its activity.

In Algeria, health problems are now an enormous burden, both health and economic, on workers, on companies and society in general. The situation is distressing, the least it can be said is the situation is alarming, even catastrophic, given the state of neglect in which the government has left the field of prevention in the workplace. «Only eighteen Algerian companies have integrated into their system, the prevention plan of occupational hazards and safety at work» (Chaïb et al., 2014). Every year, through our companies, thousands of people are victims of accidents or develop serious health problems in the workplace. More than 50,000 accidents a year were recorded resulting for year 2013 social security coverage of more than 20 billion against 19 billion Algerian dinars for 2012. During this year, the number of deaths has reached 613, 640 cases are occupational diseases in which 27% are due to chemical products. The cost is increasing from one to another and the expense is apparently very heavy, yet it is only an approximate hardly reflects the exact number of victims in the workplace, where the majority of cases occur in the margins of the formal sphere, far from any official statement (Chaïb et al., 2014; Incidents, accidents, catastrophes, 1999). These expenditures reveal serious shortcomings in health and safety that industrialized countries cannot afford prevention.

The tragedy of occupational accidents and expenditure requires a strong response from all stakeholders, both at the state level that companies and workers. The state should play a key role both in the development of the national system in Health and Safety at Work in conjunction with all sectors including the private and should define the strategic directions of the country, vital to companies in the epigraph of their actions and their forecasts (Commissariat Général du Plan, 1994). So, faced with this situation, the established modes of governance in companies should enable the latter to ensure sustainable development (Incidents, accidents, catastrophes, 1999), unfortunately this is not the case of the cement plant in question and the problem of health and

* Corresponding author.
*E-mail address:* r3chaib@yahoo.fr (C. Rachid).

http://dx.doi.org/10.1016/j.ssci.2015.01.014
0925-7535/

industrial safety does not seem to be considered seriously by the government. Thereby promoting a culture of safety has now been established as an imperative of reliability and sustainability of organizations. This safety culture is represented by the set of practices developed and implemented by the main stakeholders to manage the risks of their occupation (Chaudef-Bressy, 2002). The aim of this work has been to propose tracks to build a method and a methodological approach that would allow companies in particular the cement plant in question to undertake and succeed almost certainly a dynamic safety culture promotion, scalable and sustainable.

## 2. Problem

Safety and health at work has become a public health priority in industrialized countries and a primary concern especially for high risk industries. It is a social and societal requirement. Although the country has an important legislative and regulatory framework on which is based the national policy on the prevention of occupational risks. This device was taking its anchoring in International Labor Convention no. 155 on safety and health of workers and Convention no. 167 on safety and health in construction. Unfortunately, without any safety culture or regular monitoring of the state, all work accidents cannot be avoided. Now the policy of health and safety at work is not only a matter of laws and regulations. The latter are essential and should be applied at each company, or even in every workplace and that employers should confirm that prevention is an integral of all their activities. However, as no adequate policy and no appropriate budget have been implemented and with that intensity of human activity, its ever-increasing pace and constant intervention stressed man, the risk is constantly present. In addition, rules and regulations related to the prevention of occupational risks have been only partially implemented, not to say they did not exist on the ground and that intervention in health is limited to caretaking function. In addition, for the majority of employees, the concept of health and safety at work does no longer mean big thing and a culture of temerity or let settles (Chaib et al., 2013). Henceforth, developing a strong safety culture would be a mean of reducing the number of adverse events related to various activities in the company (Planchette et al., 2002). Henceforth, to meet these expectations, building a culture in health and safety at work, get a measurable improvement in working conditions and a reduction in occupational accidents and disease, the control of occupational hazards inflicts and should be integrated in the company program. To achieve these objectives, two stakeholder groups have to be distinguished: the exposed staff and the management: those closest to the danger and those who supervise. Safety culture is therefore the result of a dynamic based on trust between those stakeholders (Jaubert, 2009). On practices, they are largely dependent on belief systems and rules that govern the usual behavior of employees. Montesquieu, in the spirit of laws, defines a nation by two basic founding elements that interact: the laws and customs. When a people have good manners, laws became simple. Unfortunately, habits cannot be modified by setting example. Therefore, our management is based on a basic principle: we only work well that if one is safe.

In this work, tracks to build a method for practical popularization of a safety culture in the workplace have been proposed.

It can serve to managers and trainers interested in conducting a proactive approach towards sustainability in their section or in their establishment. It can also provide a basis for a company that wanting to get into a process of continuous improvement in health and safety at work. Our interest has been given to the risks generated by industrial activities and likely cause damage to persons and/or legal, to the environment as well to good in companies. The proposed approach is promising, combined with economic incentives and continuous and sustainable improvement process, allowing maintaining an acceptable standard of health and safety

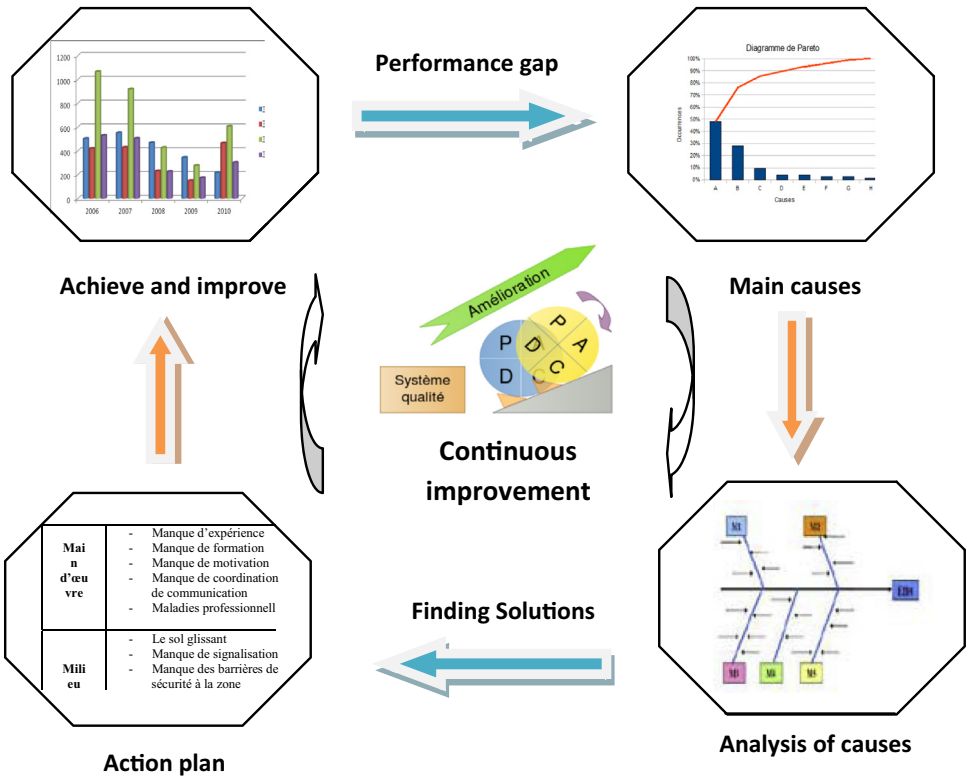


**Fig. 1.** Working methodology «continuous improvement loop».

and ensuring optimal working conditions. These are essential since they are very effective defense line if a strong safety culture can be built. The cement plant of Hamma Bouziane (Algeria) has been taken as example.

## 3. Work methodology

The working proposed method is based on the feedback experience, a posteriori approach, adverse events manifested in the company. This approach is primarily a learning tool for organizations, which can constitute a memory of risks. The feedback experience (FEX) has become a method of managing the safety of complex systems (Chevreau, 2008) to improve the quality, safety and reliability in technical and/or human point of view. This tool is expanding aims to provide the means to reflection on the experience gained from accidents and/or incidents in normal situation or disorganized, to draw the consequences, to be memorized and to be reused. It must be a source of progress and continuous improvement. The proposed approach is based on a loop of continuous improvement of technical devices, human and organizational prevention and protection against threats that can affect an organization composed of five steps, Fig. 1, namely:

*Step 1: Assessment of performance gaps SHW*. The risk assessment is a dynamic process that allows firms and organizations to implement a proactive policy on workplace risk management identifying the deficient gap between two consecutive periods and thus seek the causes which are at the origin of failures.
*Step 2: Research of the failure causes in SHW*. We research the causes of this event so that this cannot happen, and thus we determine the priority actions in the company.
*Step 3: Determination of priority actions*. The purpose of evaluation is to determine the priority actions in the business without alteration of daily actions that are inevitable for the smooth running of the approach, or even develop a plan of action.

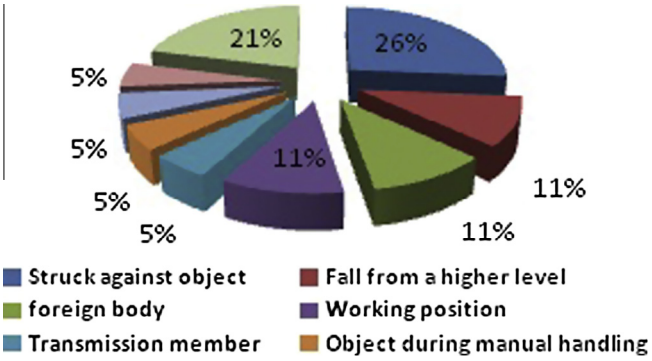


**Fig. 2.** WA distribution according to material element, year 2012.

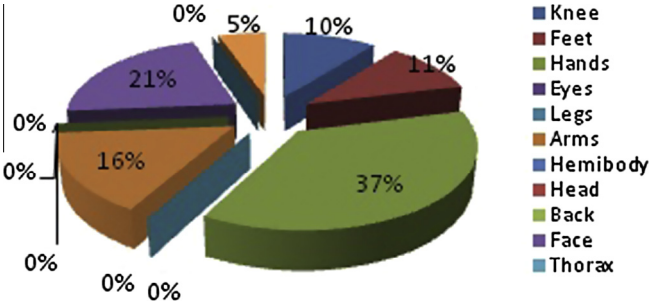


**Fig. 3.** WA distribution according to the location of lesions, year 2012.

*Step 4: Plan of action to take*. The action plan designed according to specific criteria will enable us to implement the measures that are needed to improve the safety of personnel and prevent accidents in the workplace. Ensure that all relevant risks are taken into account (and not only the immediate or obvious risks).
*Step 5: Engage in continuous improvement*. Refine action plan. Verify the effectiveness of the security measures adopted; document its results in a document and regularly point to ensure that it remains current, "most culture progresses in a company, less accidents there". Thus, accommodate to the quality approach, the notion of sustainable continuous improvement according to the well-known principle 'the Deming wheel' or 'steps PDCA'.

## 4. Application

The application is made on adverse events manifested during the years 2010, 2011 and 2012 in the cement plant of Hamma Bouziane. Thus, to fill these gaps in terms of work safety, it appears necessary as it exists in reality, posing the problem and proposing practical solutions, while referring to the results of year 2012 (see Figs. 2–10).

### 4.1. Distribution according to the material elements

*Remark 1*. The initial observations show that posture is a crucial problem and that the on ground is cluttered otherwise the major part of accidents is related to these two phenomena.

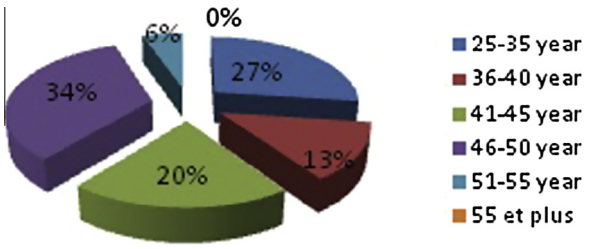


**Fig. 4.** WA distribution according to the age range, year 2012.

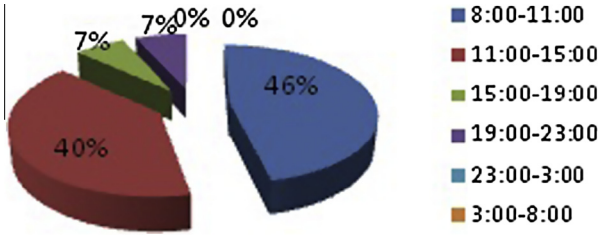


**Fig. 5.** WA distribution according to the time of accident, year 2012.

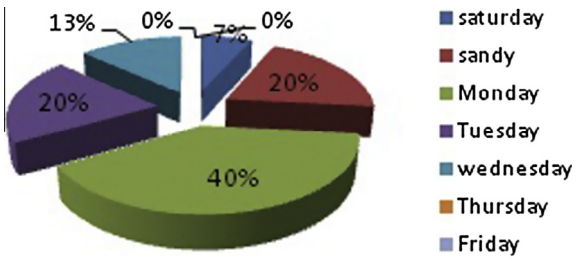


**Fig. 6.** WA distribution according to the week days, year 2012.

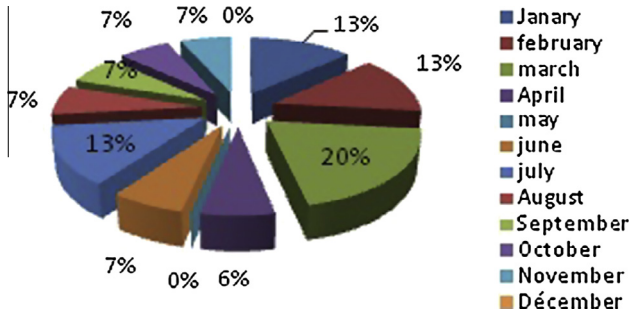


**Fig. 7.** WA distribution during the months of the ongoing year 2012.

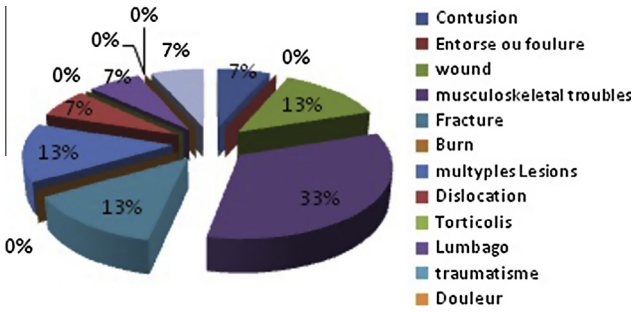


**Fig. 8.** WA distribution according to the nature of lesions, year 2012.

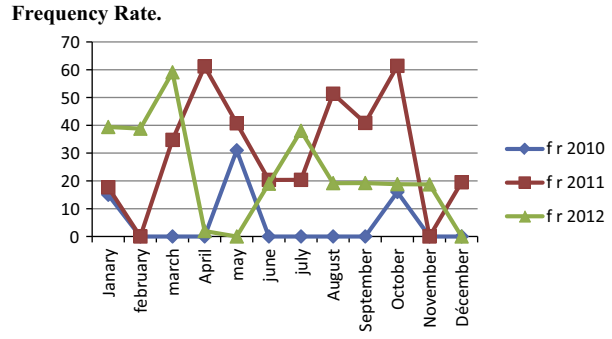


**Fig. 9.** Distribution of frequency rate during the three years.

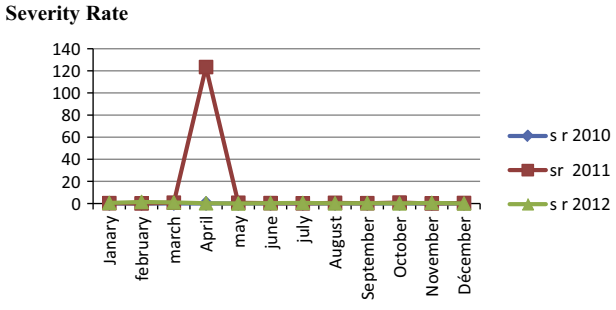


**Fig. 10.** Distribution of severity rate during the three years.

### 4.2. Distribution of work accidents according to the location of lesions

*Remark 2.* Since posture causes problems, the limbs are the most affected.

### 4.3. Distribution of occupational accidents according to the age range

*Remark 3.* The age groups most affected by work accidents are respectively ranges 25/35 and 40/46 years. It requires a socio-technical study to understand this phenomenon. That is an observation which leads to reflection.

### 4.4. Distribution according to the time of accident

*Remark 4.* The highest number of work accidents occurs between 08 h and 11 h. It is the period of productive time.

### 4.5. Distribution by day of the week

*Remark 5.* The highest number occurs on Monday. It also requires a psychological study.

### 4.6. Distribution of work accidents in the year during the month

*Remark 6.* The highest number of work accidents is January, February and March. It is the winter: Cold.

### 4.7. Distribution according to the nature of lesions

*Remark 7.* The musculoskeletal troubles: This is the most common occupational disease in la developed countries at this time (2012); it is the evil of the century. An ergonomist may in a working situation be able to update the risk factors and determinants of the TMS appearance at work.

### 4.8. Frequency rate and severity rate during the months of the 3 years

Frequency and rate of gravity during the months of the three years: these two indicators give an idea of the effectiveness of the actions to improve. Thus, their values are high, more accidents occur and have consequences in terms of work stoppages. As such, it is interesting to locate the frequency rate under the principle of "continuous improvement".

#### 4.8.1. Frequency rate

*Remark 8.* It can be noticed that the frequency rate is changing over the year 2010 (taken as a reference), which proves that the company is suffering from a shortfall, no continuous improvement in SHW at the company. Thus, must acting on the most common events to improve immediately the frequency rate.

#### 4.8.2. Severity rate

*Remark 9.* It can be noticed the severity rate is stationary, except for the fatal accidents on March to May, otherwise there is no continuous improvement in SHW, furthermore a fatal accident (almost a fatal accident l/2 years). This really requires attention to the consequences in terms of human loss, or even of work stoppages, that is why the company must invest in SHW.

## 5. Determination of priority actions

Objectively suggest a choice, that is to say, rank the importance of the elements (accidents, incidents, malfunctioning) from a knowledge base of an earlier period (history of breakdowns, accidents, incidents etc.). The results are presented as a law, called Pareto Law, whose exploitation can detect the most significant elements of the problem and taking the decisions enabling its resolution. By using this law, the most penalizing elements in order to reduce their effects can be determined:

**Table 1**
Cartography of WA.

| Function | Lost hours | Cumulation of hours | Cumulation % | Number WA | Cumulation AT | Cumulation % |
|---|---|---|---|---|---|---|
| Patroller | 6240 | 6240 | 94.47 | 8 | 8 | 14.81 |
| Mechanic | 107 | 6347 | 96.09 | 24 | 32 | 59.02 |
| Welder | 86 | 6433 | 97.39 | 7 | 39 | 72.22 |
| Electrician | 77 | 6510 | 98.56 | 3 | 42 | 77.77 |
| Driver | 30 | 6540 | 99.01 | 3 | 45 | 83.33 |
| Overseer | 23 | 6563 | 99.36 | 3 | 48 | 88.88 |
| Chief service | 21 | 6584 | 99.68 | 3 | 51 | 94.44 |
| Secretary | 12 | 6596 | 99.86 | 1 | 53 | 98.14 |
| Lubricator | 9 | 6605 | 100 | 2 | 54 | 100 |

- Determining the priority actions to start.
- Reducing the service costs and maintenance.
- Improving the reliability of systems.
- Justifying the establishment of a management policy of health and safety at work.

Table 1 summarizes the mapping of accidents in the cement plant.

Using the Pareto law, the 20% causes which have 80% of effects that affect the smooth running of the company have been determined. It can be noted that the mechanics and the patrollers are the most affected by accidents, representing 96.06%, see Table 1. This allows setting an emergency plan to determine the priority actions to initiate without of course neglecting the daily actions for maintaining an acceptable safety level au in the company.

## 6. Determination of different causes of work accidents

Among the most effective tools to seek the causes of a problem, the Ishikawa diagram or the cause/effect is used. This tool comes from industrial sector and quality approaches. It characterizes a structured representation of all causes that lead to a situation. The diagram includes the causal factors identified and categorized according to the rule of **"5M"**, namely: material, equipment, environment, methods and labor. The work been carried out at the cement plant of H. Bouziane has led to the following results, Fig. 11.

## 7. Conclusions and recommendations

### 7.1. Conclusions

This observation let us say that the company suffers from a shortfall in SHW. To maintain an acceptable level in health and safety at work, an investment in SHW and engage in a continuous improvement process based on the risk assessment and the implementation of a proactive approach in HSW has to be done while determine priority actions (Barthélemy and Courreges, 2004; Corréard et al., 2011). This allows to define a general approach to the prevention policy and to carry out the industrial risk management within the entity. It would not be good practice to seek the ways and means of better prevention of industrial and technological risks, apart from a reflection on the real data that now characterize the direct confrontation between the company and the risk. Taking into account the increasing risks from multiple sources requires, on the part of today's society, a new approach in terms of organization and in terms of decision-making practice. Therefore, every employer should take the appropriate

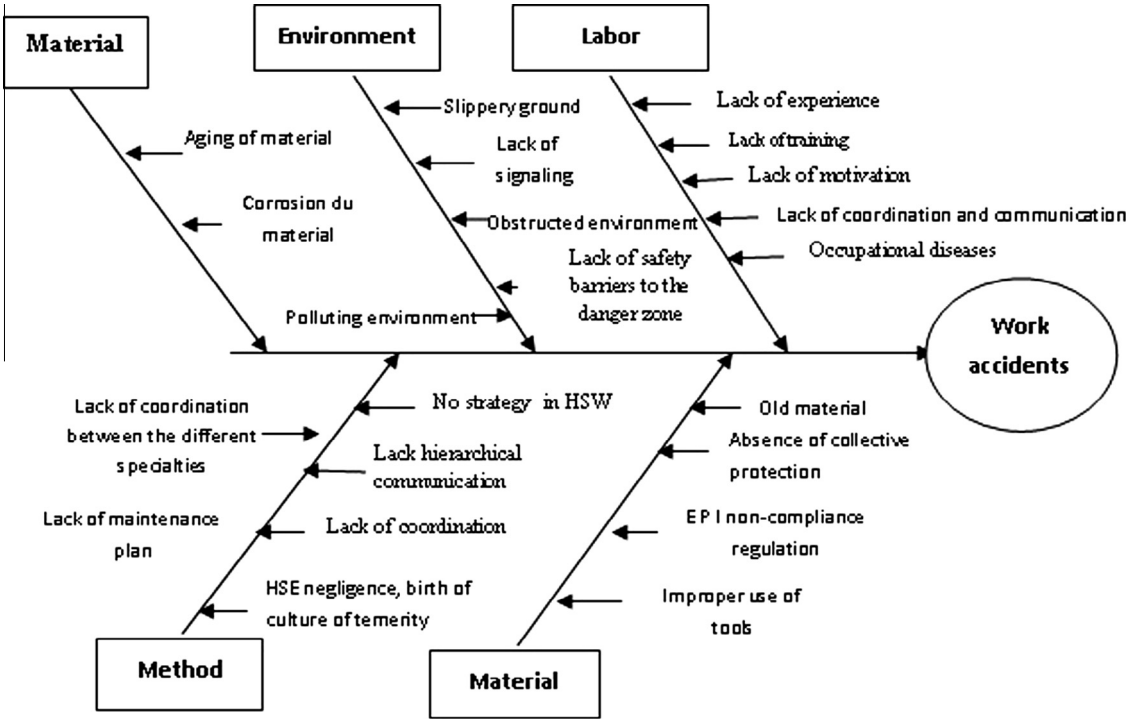


**Fig. 11.** Search for causes having effects the accident.

organizational ritual measures and the acquisition of good habits of protection and prevention. In order to know the risks, it is essential that the risks be evaluated in an objective point of view but also to decide on their acceptability. To keep them under its control, it is essential to take appropriate measures towards these risks.

Either way, in this context that we have, the recourse to the concept "safety culture" is far from trivial. This concept appears in fact as a carrier of progress, whether at the level of individuals or organizations, and only able to make a tangent of the safety results curve to the "zero accident» abscissa. In fact, after significant progress has been made in the technical and organizational areas, it remains to human beings to adopt the right attitudes and the right gestures. However, the concept "safety culture" appears at the same time as complex to handle, often manhandled and reduced to the perception of individuals towards the climate in the organization and ultimately disconnected from the reality on the ground. It is necessary to associating them to a range of other instruments such as information, education, training, social dialog, best practices, the social responsibility of companies, economic incentives and the integration into a process of continuous improvement in HSW: *Safety is an endless battle*. It proposes in parallel with actions to be taken and improvement to be made.

### 7.2. Recommendations

Implementing a culture of health and safety at work in company is not an easy task. Thus, to radically change the company in HSW, it should be remembered that «prevention is everyone's business » and translate it into practice, by involving all the staff in the proposed approach. Except, to preserve the health and improve the safety of employees, any company should engage in a process of continuous improvement. Finally, the following best practices of prevention are recommended (Chaib et al., 2012).

1. The state through the labor inspection must play its role as guardianship inter alia, we insist on the importance of a tripartite commitment and action at the national level to promote a preventive approach and a culture of safety, essential if a sustainable improvements in safety and health at work is to be achieved. Thus, any descent work must be safe work.
2. Integrate the management of health and safety in all company functions.
3. Harmonize health and safety policy with other policies of the company.
4. Developing the company autonomy prevention.
5. Encourage a multidisciplinary approach.
6. Making the identification and evaluation of a priori risk a major element of health and safety policy at work.
7. Integrating the prevention into the design of premises, equipments, jobs and working methods.
8. Analyzing accidents and occupational diseases using the causes that are more upstream.
9. Improving the risk management policy and developing the basic values of the company.
10. It should be appealed to the organizational tool for the management of safety maintenance services in our companies; in particular the historical record of the various anomalies occurred in entity (breakdowns, accidents, incidents, actions carried out, etc.). This information allow to draw a map of the experienced anomalies, and thus guide the priority actions in the company to the needs of the production in real-time.
11. The strict implementation of 5S, a simple and practical method to significantly reduce industrial hygiene problems in our companies. This application aims to the economic issues and for permanent progress. It a continuous improvement tool imported from Japan, for optimizing the organization and effectiveness of a workplace.
12. If necessary, call to the foreign experience in the field: foreign benefits.
13. Finally, it should always be remembered that «*the tiles that protect from rain were all posed in good weather*».

## References


Barthélemy, B., Courreges, P., 2004. Gestions des risques: méthodes d'optimisation globales. Editions d'organisations.

Chaib, R., Verzea, I., Benidir, M., Taleb, M., 2012. Promoting a culture of health and safety at work: Safety a permanent priority. In: 8th International Conference on Risk Analysis and Hazard Mitigation, Island of Brac, Croatia.

Chaib, R., Taleb, M., Bellaouar, A., Chetouani, Y., 2013. Pour Adopter et Diffuser les Valeurs Santé et Sécurité au Travail dans nos Entreprises Algériennes. In: QUALITA'2013, 10ème Congrès International Pluridisciplinaire Qualité et Sûreté de Fonctionnement, Développement Durable, Compiègne, France.

Chaïb, R., Taleb, M., Benidir, M., Verzea, I., 2014. Promoting in companies a successful culture of health & safery. Int. J. Safety Security Eng. 4 (1), 64–76.

Chaudef-Bressy, F., 2002. Apport du retour d'expérience à la maitrise des risques relatifs à l'hygiène, la sécurité et l'environnement dans les petits établissements industriels – Application à l'industrie du traitement thermique. Thèse de doctorat devant l'institut national des sciences appliquées de Lyon et l'école nationale supérieur des mines de Saint – Étienne. No. 285 iD.

Chevreau, F.-R., 2008. Maitrise des risques industriels et culture de sécurité: le cas de la chimie pharmaceutique. Docteur de l'Ecole des Mines de Paris. Spécialité "Sciences et Génie des Activités à Risques".

Commissariat Général du Plan, 1994. Rapport du Groupe « Intelligence économique et stratégie des entreprises » Travaux du groupe présidé par Henri Martre.

Corréard, I., Anaye, P., Brun, P., 2011. Sécurité, hygiène et risques professionnels, Dunod, Paris.

Incidents, accidents, catastrophes, 1999. Retour d'expérience. In: Annales des Ponts et Chaussées, Ingénieur science société, No. 91.

Jaubert, J.-M., 2009. L'homme acteur de sa sécurité. Politiques énergétiques, la contribution de total au débat sur l'énergie, no. 3.

Planchette, G., Nicolet, J.-L., Valancogne, J., 2002. Et si les risques m'étaient comptés! Octarès Éditions, Toulouse.